

CITIZEN SCIENCE ATMOSPHERIC SENSOR

Sensor launching

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Sensor Description

The Citizen Science Atmospheric Sensor is based upon Arduino devices coupled with the Bosch BME-280 atmospheric sensor. The device has built in WiFi connectivity, internal voltage monitoring and a PCB trace antenna. It provides an inexpensive low power method to monitor atmospheric conditions (temperature, pressure and relative humidity) within the range of a WIFI access point. Three standard AA alkaline batteries provide enough power to measure and send data to a cloud-based server (AWS) once every hour, with real time telemetry. The design, construction and implementation of this technology was provided by *Protostudios*, a part of the University of Iowa's Department of Innovation and Economic Development.



Fig. 1. Citizen Science Atmospheric Sensor.

As soon as the sensor is turned on and connected to a WiFi access point, it starts by measuring weather conditions once per minute in a period of 15 minutes. After this period, the sensor switches to monitor data hourly. This is to make sure the user can check and see if the sensor is working properly during setup. The hourly timeframe was chosen so that the sensor can provide acceptable data and preserve battery.

Launching the Sensor

1. Turn on the sensor switch, **blue light should blink once**

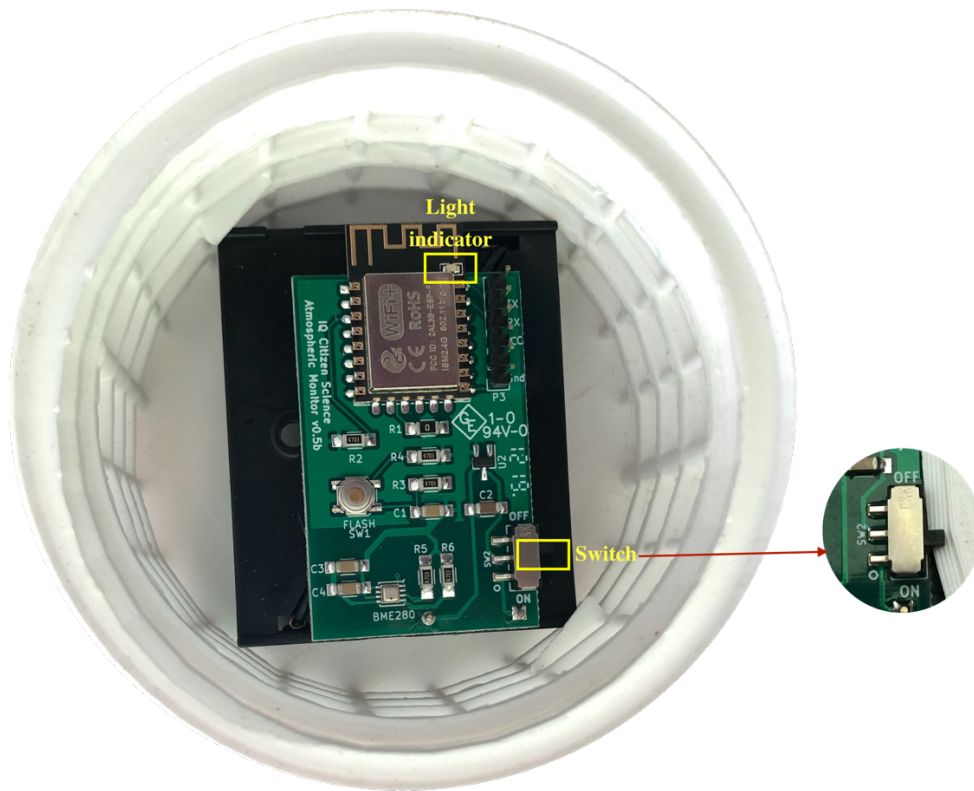


Fig. 2. Citizen Science Atmospheric Sensor assembled in a case.

2. Take your laptop or mobile device, go to the WiFi networks, and select '**Citizen_science-N**'. N is the sensor number, to keep track of the sensors.

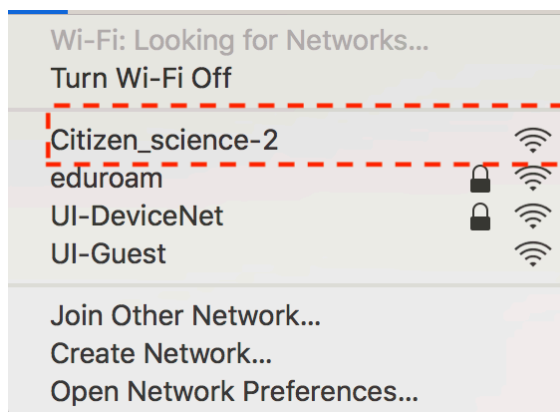


Fig. 3. Atmospheric sensor WiFi access point name.

- Depending on your web browser, it will either automatically take you to the 'login' page, shown below. If it does not, once connected to the '**Citizen_science-N**' network, type in to your web browser 192.168.4.1. Now you should be on the WiFiManager homepage, click '**Configure WiFi**'.



Fig. 4. Atmospheric sensor WiFiManager homepage.

- You should see your network-name in range (in this case UI-DeviceNet), the percent signal, and a lock indicating if it is password-protected (**Fig. 5** below).

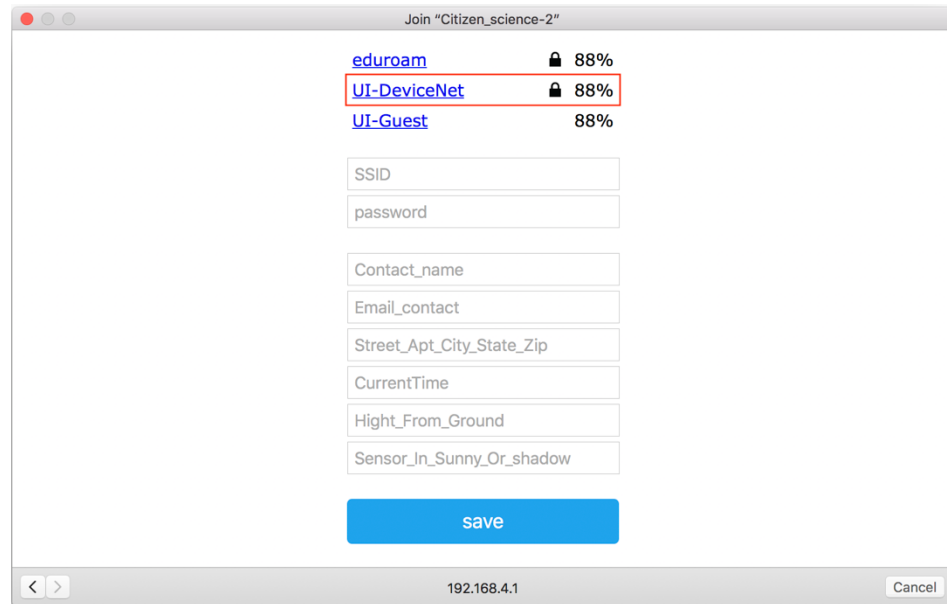


Fig. 5. Atmospheric sensor login page.

In order to connect the sensor, fill out the required information below:

SSID: WiFi network name

password: WiFi network password. If there is no password, leave empty

Contact_name: name of person to contact

Email_contact: email of person to contact

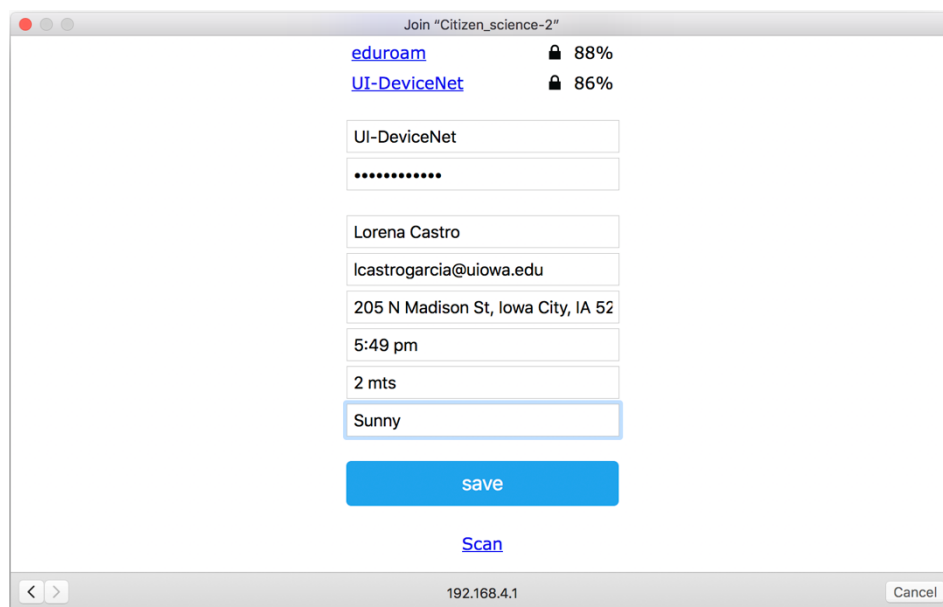
Street_Apt_City_State_Zip: address of where the sensor is

CurrentTime: time sensor is being launched (hour:minutes am/pm)

Height_From_Ground: height the sensor is from the ground (meters)

Sensor_In_Sunny_Or_Shadow: type “sunny” if the sensor is in a sunny area and “shadow” if it’s in a shaded area.

Fig. 6 shows an example of filling out in the requested fields. Once the fields have been filled, click **save**.



The screenshot shows a web browser window titled "Join 'Citizen_science-2'". At the top, there are two network options: "eduroam" with a lock icon and 88% signal, and "UI-DeviceNet" with a lock icon and 86% signal. Below these are several input fields: "UI-DeviceNet" (containing "UI-DeviceNet"), a password field (containing "*****"), "Contact name" (containing "Lorena Castro"), "Email" (containing "lcastrogarcia@uiowa.edu"), "Address" (containing "205 N Madison St, Iowa City, IA 52"), "Time" (containing "5:49 pm"), "Height" (containing "2 mts"), and "Location" (containing "Sunny"). A blue "save" button is positioned below the "Sunny" field. At the bottom of the form area, there is a "Scan" link. The browser's address bar shows "192.168.4.1" and a "Cancel" button is visible in the bottom right corner.

Fig. 6. Atmospheric sensor login page (fields filling example).

After you save, the sensor should reboot, every time it sends a measurement, the light indicator will blink blue.

If at some point your sensor isn't sending measurements, it may be caused because the batteries need to be replaced, or the Wi-Fi network can't be reached due to the SSID changed (either you change it manually, you got a new internet service, or moved the sensor to a new location with a new Wi-Fi network). If it's the batteries case, just turn the sensor off, replace the batteries and turn the sensor on again (there is no need to go through the launch process). However, if the Wi-Fi network can't be reached you need to relaunch the sensor following steps 1-4 (described above).

Mounting the Sensor

Since the sensor is going to be outside, it is important to mount it in the correct way, or else risk the weather or animals from damaging it. Here are some tips for mounting the sensor.

1. Make sure the sensor is ~2 meters off the ground. This is because air temperature is officially measured at a height of ~2 meters, or about 6 feet above ground.
2. The sensor should be in a place where rain won't be splashed inside the case, where the devices is located.
3. If you are using screws to mount the sensor, make sure there are two screws that hold the sensor in place, so the sensor doesn't rotate. Also, the open area exposing the circuit board and battery pack should be facing downwards. This is to prevent from exposing the water-sensitive parts to rain/snow and is shown in Figures 7 & 8.
4. The holes on the side of the sensor are used for mounting the sensor with zip ties or string. If you do this, make sure the sensor is mounted tightly, so it doesn't slip. This is shown in Figure 9.

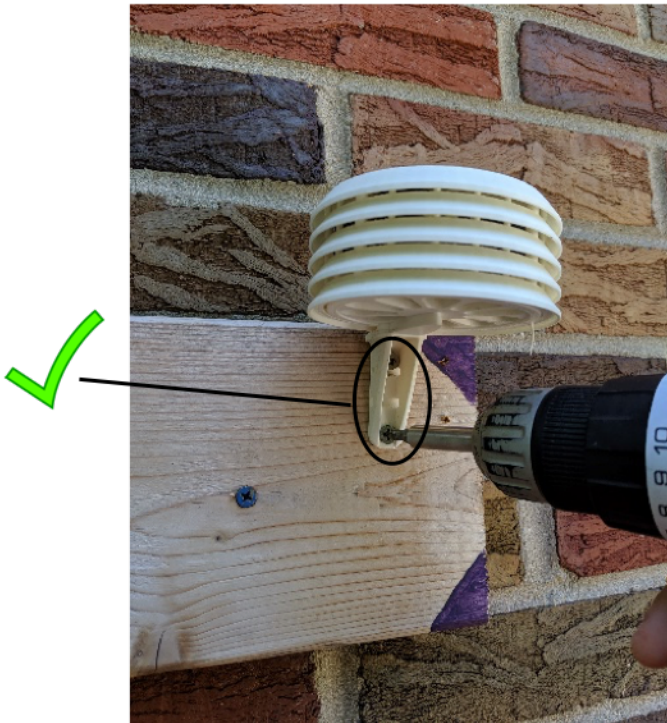


Fig. 7. *Correct sensor mounting.*



Fig. 8. *Incorrect sensor mounting.*

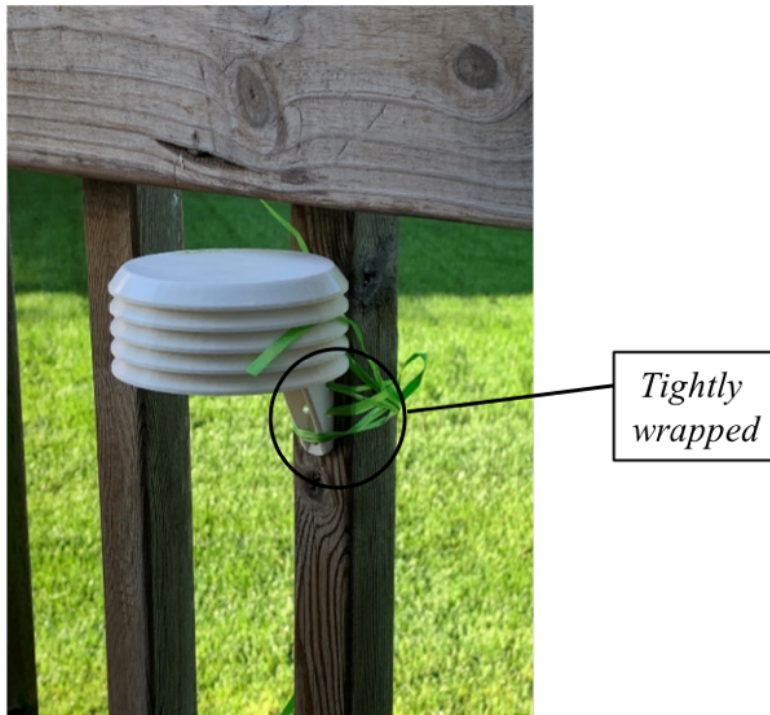


Fig. 9. *String mounted sensor.*

Accessing the Sensor Data

Once the sensor starts sending data to the cloud, the data can be downloaded and seen at this website: <https://esmc.uiowa.edu>

1. In order to see the data that the sensor is providing, navigate to the ESMC website. Under the menu “Citizen Data” click “[First look of sensor launch](#)”. This tool allows one to view the data generated by the sensor, which is especially useful right after a sensor is turned on, since data is received in the cloud almost immediately. All that is needed is to see the data is entering the “Sensor ID” which is located on the sensor’s case (e.g., **BME280_5**) and submit the query.

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Smart First look of sensor launch Environmental Monitoring

Please input the Sensor ID and Variable to test the sensor

When you enter sensor ID and the variable you would like to see, you will get a list of values, along with the time they were recorded. You can also download the data to a .csv file.

Sensor ID: BME280_20

Variable: All Temperature Pressure Relative Humidity

Submit

Timestamp	Temperature	Pressure	Relative Humidity
2019-07-19 18:30:11	26.78	982.38	40.98
2019-07-19 18:31:18	26.54	982.38	41.09
2019-07-19 18:32:25	26.27	982.26	41.72
2019-07-19 18:33:32	26.11	982.28	42.04
2019-07-19 18:34:38	26	982.22	42.35
2019-07-19 18:35:45	25.94	982.2	42.47
2019-07-19 18:36:58	25.84	982.18	42.72
2019-07-19 18:38:05	25.87	982.09	42.66
2019-07-19 18:39:11	26.47	982.15	41.59
2019-07-19 18:40:22	26.44	982.14	41.69
2019-07-19 18:41:28	26.35	982.06	41.49
2019-07-19 18:42:35	26.24	982.09	41.78
2019-07-19 18:43:42	26.17	982.11	41.88
2019-07-19 18:44:48	26.12	982.09	41.96
2019-07-19 18:45:55	26.06	982.14	42.09

Export data to CSV file

Fig. 10. Screenshot of “First look of sensor launch” tool.

- Another tool located under the menu “**Citizen Data**” → “**Environmental Monitoring**” is useful for seeing the data the sensor generates. This tool is an interactive web-application which allows exploring and retrieving data from multiple sensors, along with the forecast associated with the sensor’s geolocation. In order to start displaying a sensor into this app, it will be necessary to know it’s geolocation, or exact address where it is located. Please contact Lorena Castro García or Jun Wang via email (contact information on Pag. 11) and provide this information along with the sensor ID to have the sensor data displayed.

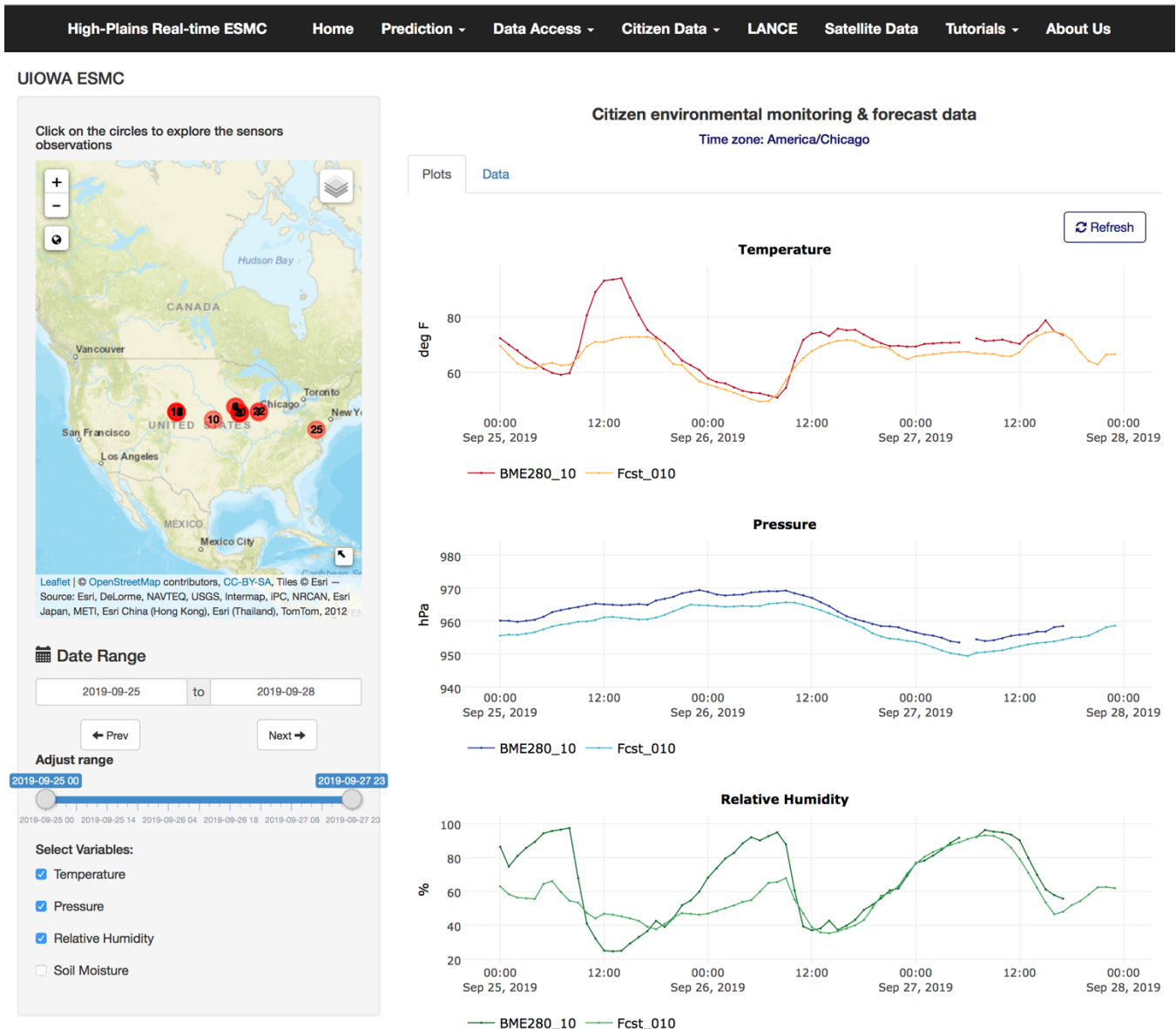


Fig. 11. Screenshot of “Environmental Monitoring” web-app.

Contact information

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